

Chapter 7: Public Health/Aquatic Life Concerns

The potential presence of toxic substances in surface water, groundwater and drinking water is a concern for individuals, businesses and governments. As more is understood about known and potential effects of individual contaminants — as well as suspected synergistic effects of multiple contaminants — the public is demanding to know more about environmental or ambient water quality and quality of water at the tap.

Federal and state requirements address these concerns, in part, through — for example — reporting requirements for communities on the vulnerability of drinking water systems to potential contaminant sources under the state's drinking water program or through protection afforded surface waters through the state's stringent provisions regulating the calculation of effluent limits for toxic substances found in NR106.

Major topical areas in this section include water quality assessments detailing the presence of and resulting impairments from toxic substances; aquatic life toxicity testing; fish consumption advisories, fish kill data, sediment contamination sites, reports of beach closings, incidents of waterborne disease and assessments of surface waters for drinking water use designation.

Water Quality Assessments - Toxic Substances

Table 10 below reports waters monitored for toxic substances and those with elevated levels of toxicants as of 2002. Streams are reported in Part III, Chapter 3. In 2002, of the 24,422 miles monitored or evaluated, 1,138 miles of rivers were partially or not supporting their designated uses due to elevated levels of toxic substances in the water column, fish tissue, or discharges.

The entire length of Wisconsin Great Lakes shoreline miles (1,017) are considered to have elevated levels of certain toxic contaminants. Pollutant sources to the Great Lakes are many, including airborne pollutants like mercury, sediments contaminated from historic discharges or activities, tributaries carrying toxic runoff, and wastewater discharges.

Table 10. Total Size of All Waterbodies Affected by Toxicants

Waterbody	Size monitored for toxicants*	Size with elevated levels of toxicants
River (miles)		1138.25 (1)/ (2)
Lakes (acres)		
Great Lakes (miles)	1017	1017 (3)

(1) From USEPA database includes waterbodies monitored and evaluated

(2) Stream miles under fish consumption advisories

(3) Based on fish consumption advisories

Aquatic Life Toxicity Testing

In toxicity tests, aquatic organisms are exposed to samples (effluent, sediment, ambient waters) for a specific time period, and then are compared to a control treatment (e.g., an exposure of the test organisms to dilution water with no effluent added) to determine whether toxicity is present at levels of concern to the environment. There are two types of WET tests - acute and chronic. The objective of an acute test is to determine the concentration of test material that produces a harmful effect (usually mortality) during a short term exposure under controlled conditions. Chronic tests are used to predict the concentrations that interfere with normal growth, development, and reproductive potential of aquatic organisms. During a chronic test several life stages (or the entire life cycle) of the organism are continuously exposed to the test material.

University of Wisconsin-Madison's State Laboratory of Hygiene

The WDNR works cooperatively with UW-Madison's State Laboratory of Hygiene (SLH) to main-

tain a biomonitoring laboratory. The SLH maintains cultures of several fresh water species and is capable of performing acute and chronic toxicity tests on effluent, ambient waters, and sediment samples collected statewide. The laboratory also provides sample collection services for these and other tests. SLH staff have participated on WDNR policy teams dedicated to the development of new and improved toxicity testing methodologies. Additionally, WDNR and SLH staff assess the applicability of alternative toxicological assessment methods to other WDNR watershed management programs.

Each year, the SLH accepts requests for toxicity testing from WDNR basin engineers and permits staff. WDNR staff select facilities to be tested by the laboratory in order to collect data for compliance inspections, permit reissuances, and enforcement situations. The tests completed in 2002-2003 are summarized below (see Table 11).

Table 11. Summary Of SLH Toxicity Test Results For 2002-03

Sample type	#of acute	Results		#of chronic	Results	
		Pass	Fail		Pass	Fail
WPDES Industrial & Industrial	33	33	0	33	20	13
WPDES WDNR-owned fish hatcheries	7	7	0	7	7	0
Totals	40	40	0	40	27	13

NA = not applicable

Acute and chronic WET tests performed by the SLH on municipal and industrial wastewaters made up the majority of toxicity tests conducted in 2002 and 2003. While the majority of wastewater effluent samples were non-toxic, 13 of 33 (39%) of the chronic tests performed by the SLH during 2002-2003 indicated the presence of chronic toxicity at levels of concern. Because most SLH tests are a result of WDNR staff selecting facilities that have suspected toxicity problems (except for WDNR-owned fish hatcheries, where SLH testing is required by WPDES permits), it is not surprising that a large number of chronic tests at these facilities failed. Additional data collected by the SLH in these situations is often used in permitting and enforcement situations to help staff make better-informed decisions. In many of these cases, the cause(s) of toxicity is not determined by the SLH during these tests, but the permittee is required to address the situation. Additional testing and/or toxicity identification is often required in subsequent WPDES permits, to further characterize the potential for significant effluent toxicity from these facilities.

The SLH also applied acute and chronic toxicity testing techniques to other sample types. WDNR's sediment management program continues to benefit from the ability of laboratory staff to conduct sediment toxicity tests. Acute and chronic toxicity tests using *C. dubia*, a midge larvae (*Chironomus tentans*) and an amphipod (*Hyalella azteca*) were performed in 2002 and 2003.

Stormwater runoff and receiving water samples from areas near the Milwaukee airport were analyzed for toxicity in order to determine the potential of deicing chemicals to impact nearby surface waters. Surface water samples from around the state were tested to assess the potential for acute and chronic toxicity in lakes and rivers at those sites. Individual chemicals were also tested at the lab in order to provide toxicological data to assist the Department in developing water quality criteria. Other testing at the lab in 2002-2003 included tests to:

- to assess the cause of fish kills and in emergency spill situations;
- to determine the potential impacts to surface waters from landfill leachates;
- to investigate the sensitivity of early life stages of burbot and northern pike, in support of WDNR efforts to develop water quality standards for ammonia; and
- to determine whether endocrine disrupting compounds were present in source water, drinking water, and wastewater effluent samples.

WDNR/SLH efforts in the next biennium will continue to emphasize monitoring for WPDES-

permitted facilities. Efforts will also be made to generate additional sediment and ambient data and to supplement the toxicological database for water quality criteria, where needed.

Table 12. Whole Effluent Toxicity (WET) Test Results
Calendar Years 2002-03

Acute			Chronic		
Results	Number Tests		Results	Number Tests	
	Pass	Fail		Pass	Fail
506	483	23	469	416	53

WPDES Permit-Required Toxicity Testing

All surface water dischargers with a WPDES permit are evaluated by WDNR staff to determine their potential for acute and chronic toxicity at the time of permit reissuance. If it is determined that a significant potential for effluent toxicity is present, individual permits require that acute and/or chronic whole effluent toxicity (WET) monitoring be performed during the permit term. The need for WET testing is evaluated using data regarding available dilution, industry type, type and number of industrial contributors to municipal treatment plants, detection of chemical-specific compounds, additive use, and other factors. WET tests completed for WPDES permit compliance during calendar years 2002 and 2003 are summarized below (see Table 12).

Whole Effluent Toxicity (WET) Test Results

During 2002-2003, a total of 975 WET tests (506 acute, 469 chronic) were completed by permittees and submitted to the Department as required by their WPDES permit. Of these tests, 23/506 (4.5%) acute tests and 53/469 (11%) chronic tests exhibited toxicity at levels of concern. In those cases where repeated or severe toxicity was noted, facilities are required to perform follow up testing, toxicity identification evaluations in an attempt to identify the source(s) of toxicity, and they may get WET limitations in subsequent WPDES permits.

The WDNR will continue to implement its WET program in the next biennium, including an emphasis on additional WET monitoring and toxicity problem resolution for WPDES-permitted facilities.

Fish Tissue Monitoring Program

During calendar years 2002-2003, over 1800 fish samples were collected as a part of the fish contaminant monitoring program (Table 13 below (April 2004)). This includes fish samples that were collected as a part of the normal fish contaminant monitoring program, samples collected by cooperators, and samples collected under special projects and research.

In 2002-2003, samples were collected from approximately 137 lake locations, 36 sites in flowing waters, and 19 areas of Lakes Michigan and Superior (preliminary data as of April 2004).

Each year WDNR collects and analyzes samples of fish tissue from Wisconsin's inland waters and the Great Lakes, including their tributary streams. The objectives of the fish contaminant program includes protection of fish consumers by determining the levels of bioaccumulatory contaminants in the edible portions of fish and compare these levels to health guidelines as determined by the Wisconsin Division of Health.

Samples from the Great Lakes were analyzed for PCBs, pesticides, and mercury, while samples

from river systems were primarily analyzed for PCBs and mercury. Fish samples from inland lakes were analyzed almost exclusively for mercury.

Fish consumption advisories are issued for certain species and sizes of fish from given areas where the concentrations of chemicals in the fish flesh exceed the health advisory levels. Fish contaminant data is also used to make natural resource and environmental management decisions.

Fish Consumption Advisories

Wisconsin issues general advice that applies to most inland waters where other pollutants or where mercury concentrations do not require more stringent advice. The general statewide advisory is based on US EPA's reference doses for mercury and typical levels of mercury found in Wisconsin fish based on the mercury concentration data that Wisconsin amassed over the last 20 years.

In addition to the statewide advisory that applies to most inland waters, more stringent consumption advice applies where fish have been found to contain higher concentrations of mercury or PCBs and other pollutants. The 2003 update of the Wisconsin Fish Consumption Advisory lists fish from 50 of the more than 2,000 lakes, river segments, and border waters tested (Table 14) due to the presence of PCBs and other organic chemicals. The number of surface water segments with PCB-based advisories has remained fairly constant since 1990. The 2003 update of the Wisconsin fish consumption advice lists fish from 93 specific surface waters due to higher concentration of mercury. See Table 14 for a list of health criteria used for Wisconsin's advisories

Table 13. Wisconsin's Fish Contaminant Monitoring and Cumulative Advisories

Year	Sites Sampled**	Samples Collected**	TOTAL Reaches or Waters w/Advisories PCB/Mercury
Prior to 1980	233	3,003	7/0
1980-1989	978	11,139	22/161
1990-1999	770	11,565	58/322
2000-2001	209	1,824	59/331
statewide mercury advisory adopted			
2002	110*	997*	50/92
2003	96*	881*	50/93
Total	1,634*	29,409*	

* Total number not yet available, based on data available as of April 2004. (Total cumulative number of sites does not include duplicate visits to a site.) ** includes samples collected and/or analyzed by cooperators

Table 14. Wisconsin Fish Consumption Advisory Guidelines

Contaminant	Population	Concentration	Advice
PCB¹	All	< 0.05 ppm	Unlimited Consumption
		0.05 – 0.2 ppm	1 meal/week or 52 meals/year
		0.2 – 1.0 ppm	1 meal/month or 12 meals/year
		1.0 – 1.9 ppm	6 meals/year
		> 1.9 ppm	Do Not Eat
Mercury	Sensitive Group ²	< 0.05 ppm	Unlimited Consumption
		0.05 – 0.22 ppm	1 meal/week or 52 meals/year
		0.22 – 1.0 ppm	1 meal/month or 12 meals/year
		> 1.0 ppm	Do Not Eat
	General Group ²	<0.16 ppm	Unlimited Consumption
		>0.16 ppm	1 meal/week or 52 meals/year
Dioxin³	All	< 10 ppt	No Advice Given
		> 10 ppt	No one should eat
Chlordane	All	< 0.16 ppm	No advice given
		0.16 - 0.65 ppm	1 meal/week or 52 meals/year
		0.66-2.82 ppm	1 meal/month or 12 meals/year
		2.83-5.62 ppm	6 meals/year
		> 5.62 ppm	No one should eat

1. Although this advice is based on reproductive health effects, the same advice is given for women, children, and men to protect against other potential health effects such as immune suppression and cancer

2. Sensitive group includes pregnant women, women of childbearing age, and children under age 15. General Group includes women beyond childbearing age and men.

3. Sum of total dioxin equivalence expressed as 2,3,7,8 TCDD based on dioxin and furan congeners and EPA human health TEFs.

Sites of known sediment contamination

The table below lists selected sediment sites; the status column level of management. The full table of contaminated sediments can be found at dnr.gov.wi/org/wm/wqs/sediment.html

Table 15: Sites of Known Sediment Contamination

PROJECT NAME - RP Name	Basin & WATERBODY	Status* *	CURRENT & PROJECTED STATUS FY 2002-2003	CONTAMINANT
Appleton MGP - WE Energies	Lower Fox River GMU - Fox River	5,6	Initial site assessment completed; coal tar found in the river and removed in August 2002. Coal tar in River, on bank and all unsaturated soils (2 acres) excavated summer 2003. Coal tar on bedrock - few to no sediments. In-situ stabilization of saturated soils on site in progress. Anticipated ISS completion is July 31, 2004. Thermally treated soils will be mixed with organics and returned to site. Post-remediation monitoring is planned.	PAH, BTEX, CYANIDE, STYRENE
Fond du lac River - no RP	Upper Fox R. GMU - Fond du Lac River	2	Initial sediment sampling indicated potential high levels of metals and a potential coal gas site impact. Toxicity samples collected in fall of 2000. Impacts were noted but no specific RP to go after. Water program will need to assess the need for any work in the river, then come to RR for assistance.	METALS
Fond du lac MGP - Alliant Energy	Upper Fox R. GMU - Fond du Lac River	3	Sediments investigated and ecological study completed, low impact PAHs. DNR sent NFA letter for seds to Alliant Energy on 10-10-1996. Nad portion of clean-up still ongoing (groundwater pump and treatment)	PAHS, BTEX CYANIDE
Green Bay MGP - WPS	Upper Fox R. GMU - Fox River	2	Initial sediment assessment completed. Evaluate need for additional investigation before proceeding with a remedy.	PAHS, BTEX CYANIDE
Hayton Millpond - Tecumseh	Lakeshore GMU - Pine & Jordan Creeks, & ditches; Hayton Millpond	4,5	Site investigations complete, and FS completed. Discussions for remedy are taking place. Initial source removal completed in OU-1 in 2001. OU-1 (segments 1 through 6) removal completed in fall 2001, OU-1 segment 7 and OU-2 (workplan in progress).	PCB'S
Hewitt Machines - Neenah Redevelopment Authority (John Bergstrom)	Lower Fox River GMU - Fox River	1	Sediment sampled, needs further investigation. Waited for final ROD from EPA. This area will not be addressed under Fox River cleanup plan and needs to be addressed by RP.	PCBs
Kewaunee Marsh - Wis. Central Railroad, DNR state lead	Lake Shore GMU Kewaunee River	4	Interim remediation measures implemented. Phase II of SI/FS underway. Funding for additional monitoring sought via GLNPO grant. Grant awarded 2003-2005 doing continued monitoring and arsenic speciation at this time. Recently submitted second grant for treatability studies.	ARSENIC

Restrictions on Bathing Areas

The 2003 beach season earmarked the implementation of the first comprehensive beach-monitoring program in the State of Wisconsin. Beach Water Quality Standards staff at the Wisconsin Department of Natural Resources secured grant funding from U.S. EPA for the development of a comprehensive beach-monitoring program. This effort is being directed at Great Lakes coastal waters, namely Lake Michigan and Lake Superior. The purpose of the program is to monitor selected beaches along the Great Lakes in accordance with the Beaches Environmental Assessment & Coastal Health (BEACH) Act requirements. The program also allows for prompt notification to the public whenever bacterial levels exceed EPA's established criteria and establishes a beach monitoring and public notification plan that assists communities along the lake shore to improve their ability to monitor and notify beach users of risks associated with high bacteria levels.

In March 2001 the Department solicited the assistance of local health department officials and interested parties and formed a 12 member BEACH Act Workgroup. The goal of the Workgroup was to assist the Department in developing a consistently implemented beach monitoring and public notification program. The program was developed in accordance with EPA published guidance and performance criteria and involved the following:

- Identifying all public beaches along Lake Michigan and Lake Superior
- Evaluating and classifying each beach as "high", "medium" or "low" priority.
- Developing a monitoring scheme for each priority category
- Standardizing testing and sampling methods
- Developing methods to notify the public of health risks
- Developing methods to notify EPA
- Allowing for public input

For the purpose of the BEACH Act, a beach was defined as:

"A publicly owned shoreline or land area, not contained in a man-made structure, located on the shore of Lake Michigan or Lake Superior, that is used for swimming, recreational bathing or other water contact recreational activity."

A total of 173 public beaches along Lakes Michigan and Superior were identified as staff literally walked the coast to geo-locate each beach via the use of GPS and GIS technologies. County maps locating each beach were developed indicating the adjacent coastal recreation waters, points of access by the public, length of beach, as well as any known potential sources of pollution.

In addition to collecting GIS data, a survey was designed to assess the effectiveness of current notification procedures, and to identify our audience. Field staff also recorded the type of terrain within 5 miles of the beach, number of point source discharges, any known point and non-point sources of pollution, land use (farms, animals, houses, marinas, industry, restrooms, parking lots), and beach populations (bathers in/out of water, waterfowl, sand sports, water sports).

In December 2002 and January 2003, public meetings were held at locations around the state to present the BEACH Act Workgroup's proposals and solicit questions and comments from the public. Public comment was very instrumental in the beach ranking and public notification decisions.

With the help of guidance provided by EPA, the Workgroup designed a tiered monitoring plan for beaches in each of the priority categories. The general monitoring plan includes the following:

- Monitoring for all beaches will begin one week prior to the swim season
- Samples shall be collected from the middle of the typical bathing area or for longer beaches one sample shall be collected for every 500 meters of beach.
- Samples shall be collected where 24 to 30 inch depth is first encountered and taken 6 to 12 inches below the surface of the water.
- Additional samples shall be collected whenever there is a heavy rainfall, a known pollution event where the potential exists for fecal contamination and immediately following an exceedance of the water quality criteria.

More specifically, high priority beaches will be monitored at a minimum of 5 days each week, medium priority beaches will be monitored at least twice weekly and low priority beaches will be

monitored once weekly or on a case-by-case basis.

A goal of the Wisconsin beach program is to produce a comprehensive communication process that will best inform the public about beach water health risks and water quality issues in general. Information obtained from the Social Survey and the public meetings was used to help determine the best methods to notify the public. Several products were developed for the Wisconsin program. A standard format for statewide beach advisory, beach closure, and beach open signs was developed. The signs were distributed to all beaches involved in the monitoring program. The same signs will be used consistently among all the beaches along the Great Lakes. Signs were developed in three languages: English, Spanish, and Hmong.

An informational brochure was developed to distribute to the public. The brochure addresses concerns expressed by survey respondents. The brochures describe in detail the circumstances under which advisories will be posted and removed and under which a beach will be closed and re-opened.

Wisconsin has partnered with USGS and the Southeast Beach Task Force to develop the Great Lakes Beach Health Website. Funds from the BEACH Act grant was used to enhance the existing Southeast Wisconsin Beach Health website that is administered by the USGS in conjunction with the Milwaukee Health Department. The public will have access to real time data and advisory information for all beaches monitored along the Great Lakes borders.

The DNR website itself will feature a page about beach water quality, public health and the BEACH Act.

www.wibeaches.com

Water Quality Standards for Bacteria

Water quality standards define a relationship between the amount of bacteria in the water and the potential risk to human health. Swimming in water with bacteria concentrations that are in compliance with the standard will not eliminate the risk of illness, but the risk of disease due to exposure is decreased.

USEPA-established guidelines were derived from studies conducted in the 1970's and 1980's. In 1986 USEPA recommended that *E. coli* and/or *Enterococci* be used as an indicator of fecal contamination. The USEPA standard was set at a geometric mean of 126 colonies per 100 milliliters (mL) for *E. coli* in freshwater systems and 33 colonies per 100 mL for *Enterococci* in marine systems. These numbers are correlated with an illness rate of 8 individuals per 1,000 swimmers. Wisconsin's water quality standards are currently expressed as a fecal coliform standard. The Clean Water Act, as amended by the BEACH Act, requires Wisconsin to adopt new or revised water quality standards for pathogens and pathogen indicators for which USEPA has published criteria. Wisconsin has convened a Bacteria Standards Technical Advisory Committee and is in the process of adopting EPA's new criteria for *E. coli* and revising the applicable disinfection policy.

Economic Impacts of Beach Pollution

According to a report by the Natural Resources Defense Council, at least a third of all Americans visit coastal and Great Lake counties and their beaches annually. Recreational water tourism, attributable in part to clean beaches, generates substantial revenues for state and local governments. Polluted beaches not only cost local economies tourist dollars and jobs, but they also cause a loss to those who had planned to visit the beach and swim in the water. Economists estimate that a typical swimming day is worth \$30.84 to each individual. Depending on the number of potential visitors to a beach, this "consumer-surplus" loss can be quite significant.

Addressing the sources of pollution so that beach water does not pose a health risk is the optimal solution that will take significant time and money. In the meantime however, it makes sense from a public health perspective to monitor beach water and advise beach users of health risks associated with elevated bacteria levels at contaminated beaches. Such advisories, if used effectively, can provide beach-specific information that will discourage beach users from swimming and running the risk of getting sick. Given the large number of people using beaches, as well as the substantial income from recreational water tourism, the cost of establishing a beach-monitoring program is reasonable and will be supported.

Source Water Assessment Program

The 1996 Amendments to the Safe Drinking Water Act require states to have an USEPA-approved Source Water Assessment Program (SWAP). The purpose of the program is to protect public health by providing information that can be used to prevent contamination of public water supplies. Other benefits include: preserving water resources for future generations; avoiding the expense of cleaning up a contaminated water supply or finding alternative sources of water; reducing system costs by providing the information needed to apply for a waiver from specific monitoring requirements; and encouraging economic growth by assuring an abundant supply of clean water.

In 2004, Wisconsin is in its fifth year of implementing the Source Water Assessment Program (SWAP). Assessments for each public water supply include: 1) delineation of source water area boundaries; 2) inventory of significant potential sources of contamination within those boundaries; 3) determination of susceptibility for each system; and 4) release of the assessment results to the public water supplier and to the public. Assessments must be completed for both groundwater and surface water systems.

Source water assessments for drinking water systems using surface water are nearly complete. These systems provide drinking water to 1.5 million people in communities along Lakes Michigan, Superior and Winnebago. Surface water source water areas are shown below. Source water assessments for drinking water systems using groundwater are in various stages of completion. Municipal systems were targeted to be completed by the end of 2003 and remaining public water systems will be assessed by the end of 2004.

Figure 33. Surface Water Source Water Protection Areas developed through the Source Water Assessment Program under the Safe Drinking Water Act.

